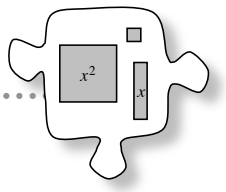
3.1.5 Are they related?



Perimeter and Area of Algebra Tile Shapes

People often assume that area and perimeter are related. It seems reasonable that if the area of a shape gets bigger (or smaller), then its perimeter should also get bigger (or smaller). But is this always true? In Chapter 1 you learned that the "tiles" could stay the same, but you could increase the "toothpicks" by changing the arrangement of squares. In this lesson you will continue to investigate whether there is a relationship between perimeter and area using algebra tiles.

As you work with your team, it is important that you share your ideas so that you are able to understand many different ways of **seeing** the shapes. Be prepared to **justify** how you are finding perimeters and how you are simplifying the expressions. Ask yourself these questions to help you to explain your **reasoning**:

How can I see the perimeter?

Where am I adding (or covering) length?

How can I rearrange the tiles?

3-43. HOW MANY PERIMETERS?

Obtain a set of algebra tiles from your teacher. For each problem below, use exactly three x-tiles to build a shape with the specified perimeter. Sketch the shapes on your paper, label the sides, and show how you combined like terms. Be prepared to **justify** your answer.

a. $P = 2x + 6$ b. $P = 4x + 2$

c. $P = 6x + 2$

3-44. Look at the shapes you made in problem 3-43. How do the areas of each of the shapes compare? How do the perimeters compare? Explain.

3-45. Build and sketch a shape with an area of $x^2 + x$ square units and a perimeter of $6x$ units.

3-46. The shapes you made in problem 3-43 each had a different perimeter, but each one used the same algebra tiles. Can you make more than one perimeter with *any* collection of algebra tiles? Assume the tiles share a complete side. Consider the three different sets of tiles listed below:

Collection I: one x^2-tile and one x-tile

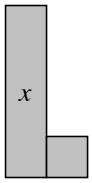
Collection II: one x^2-tile and one unit tile

Collection III: two x^2-tiles

a. With your team, make shapes with each pair of tiles that have different perimeters. Make as many different perimeters as you can. Remember, a perimeter is only different if the expression is different after you combine like terms. Each time you create a new perimeter, write it down and sketch the shape.

b. When the areas of two shapes are the same, are the perimeters equal? If so, explain why. If not, give an example in which they are not.

3-47. Build the shape at right in the center of your table, and sketch it on your paper.

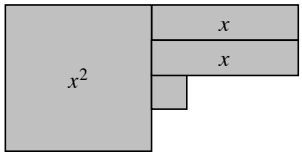


a. Write an expression for the perimeter of the shape.

b. Where could you add another unit tile to the shape without changing the perimeter? Decide with your team where to put it, then sketch the new shape on your paper. Label the sides and find the perimeter.

c. Are the areas of the two shapes the same or different? Explain your **reasoning**.

3-48. **Additional Challenge:** In the shape at right, one of the x lengths on the x^2-tile is partially covered by three 1-unit lengths. What happens to the perimeter if x has a value less than 3? Investigate this by answering the questions below.



a. Write an expression for the perimeter and for the area of the shape.

b. Use your expressions to predict the perimeter and area of the shape when $x = 4$, $x = 3$, $x = 2$, and $x = 1$.

c. Draw the algebra tile diagram on grid paper to **scale**, using each of the four side lengths. In other words, first draw all of the sides of length x so that they are 4 units long. Then, draw the diagram again and make all of the sides of length x just 3 units long. Do the same for $x = 2$ and $x = 1$.

d. Use your diagrams to measure the actual area and perimeter of each shape. What do you notice? Can you explain why this happens?

Review & Preview

3-49. Evaluate each expression for the given value.

a. $2a - 7$ when $a = 3$

b. $10 + 4m$ when $m = -2$

c. $9 + (-2n)$ when $n = 4$

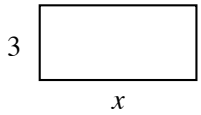
d. $\frac{x}{2} + 5$ when $x = 6$

3-50. The Kennedy High School cross-country running team ran the following distances in recent practices:

3.5 miles, 2.5 miles, 4 miles, 3.25 miles, 3 miles, 4 miles, and 6 miles.

Find the mean, median, and mode of the team's distances.

3-51. Sketch the rectangle at right on your paper. Calculate the perimeter and area for the given x-values.



a. $x = 5$ b. $x = 9$ c. $x = 4.6$

3-52. Where would the point $(11, -18)$ be after each transformation described below? Write an integer expression to find each new coordinate.

a. Reflect $(11, -18)$ across the x-axis, then reflect that point across the y-axis.

b. Translate $(11, -18)$ 5 units to the right and 3 units down.

3-53. Set up a 4-quadrant graph and graph the points below to make the 4-sided shape $PQRS$.

$P(-2, 4)$ $Q(-2, -3)$ $R(2, -2)$ $S(2, 3)$

a. What shape is $PQRS$?

b. Find the area of the shape.